Interactive LISREL: User's Guide

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4.3 Creating Syntax by Drawing Path Diagrams

LISREL for Windows allows the user to create LISREL or SIMPLIS syntax by drawing the appropriate path diagram on the screen and then building the corresponding syntax directly from the path diagram. This procedure will be demonstrated by fitting a CFA (Confirmatory Factor Analysis) model to the data. To obtain correct standard errors of the estimators of the parameters, the CFA model should be fitted to the observed covariance matrix. However, in order to illustrate how to build syntax from a path diagram, the model will be fitted to the available correlation matrix.

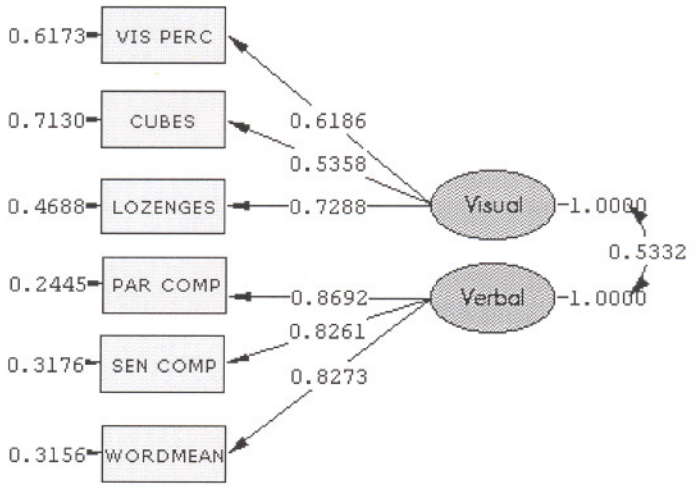
In confirmatory factor analysis, one builds a model assumed to describe or account for the empirical data in terms of relatively few parameters. The model is based on *a priori* information about the data structure in the form of a specified theory or hypothesis or knowledge from previous studies based on extensive data.

Holzinger & Swineford (1939) collected data on twenty-six psychological tests administered to 145 seventh- and eighth-grade children in the Grant-White school in Chicago. Six of these tests were selected and for this example it was hypothesized that these measure two common factors: visual perception and verbal ability such that the first

three variables measure visual perception and the last three measure verbal ability. The six selected variables and their intercorrelations are given below:

VIS PERC	1.000					
CUBES	0.318	1.000				
LOZENGES	0.436	0.419	1.000			
PAR COMP	0.335	0.234	0.323	1.000		
SEN COMP	0.304	0.157	0.283	0.722	1.000	
WORDMEAN	0.326	0.195	0.350	0.714	0.685	1.000

The path diagram for this model is given below:



Chi-Square=4.37, df=8, P-value=0.82193, RMSEA=0.000

The corresponding SIMPLIS syntax file is:

```
Six Psychological Variables-A Confirmatory Factor Analysis
Observed variables
'VIS PERC' CUBES LOZENGES 'PAR COMP' 'SEN COMP' WORDMEAN
Correlation Matrix From File EX5.COR
Sample Size: 145
Latent Variables: Visual Verbal
Relationships:
'VIS PERC' - LOZENGES = Visual
'PAR COMP' - WORDMEAN = Verbal
Number of decimals = 4
Print Residuals
End of Problem
```

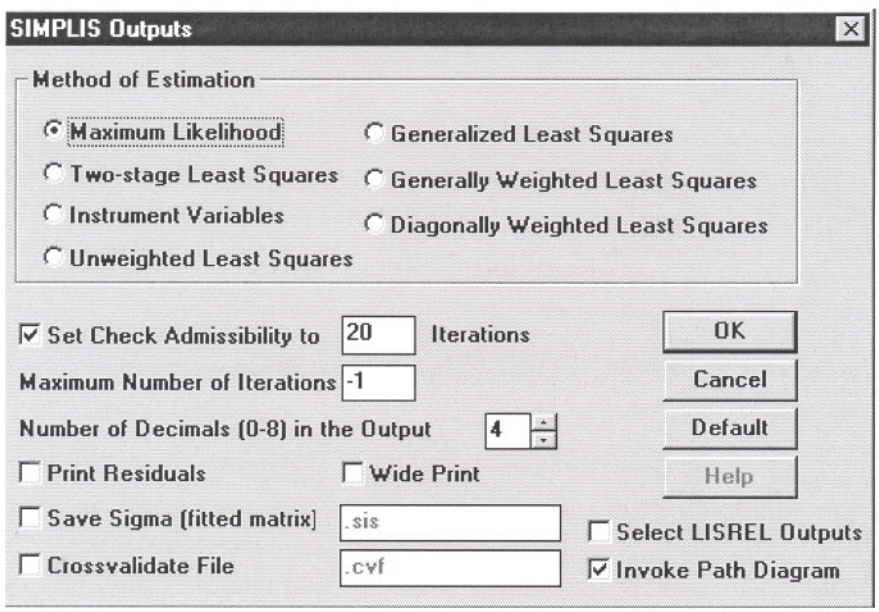
Some important aspects contained in the SIMPLIS syntax file given above are

- The correlation matrix is read from an external file
- There are two latent variables in the model: *Visual* and *Verbal*
- The statement `Number of decimals = 4` specifies that we wish to have the results in the output file given to an accuracy of four decimals. LISREL uses two decimals by default.

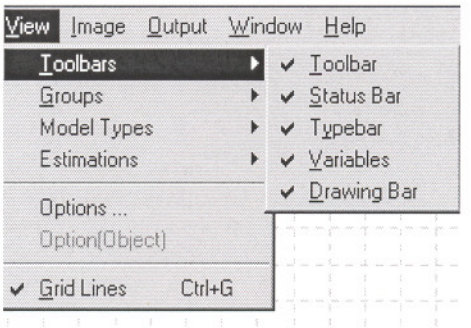
4.3.1 Title, Labels and Data

Select the ***File, New*** option and click on ***Path Diagram***. In the ***Save As*** dialog box, select a filename and a folder in which the path diagram should be saved. For the present example the folder chosen is **splex** and the file name selected is **cfa6.pth**. When done, click ***Save***.

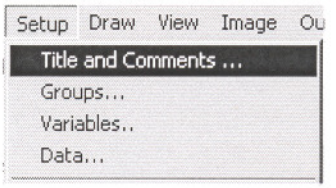
From the ***Output*** menu select ***SIMPLIS Outputs***. The dialog box below will appear. Customize this dialog box according to your preferences. For example, change the ***Number of Decimals in the Output*** option to 4. Make sure that the ***Invoke Path Diagram*** check box (the default) is checked. When done, click ***OK***.



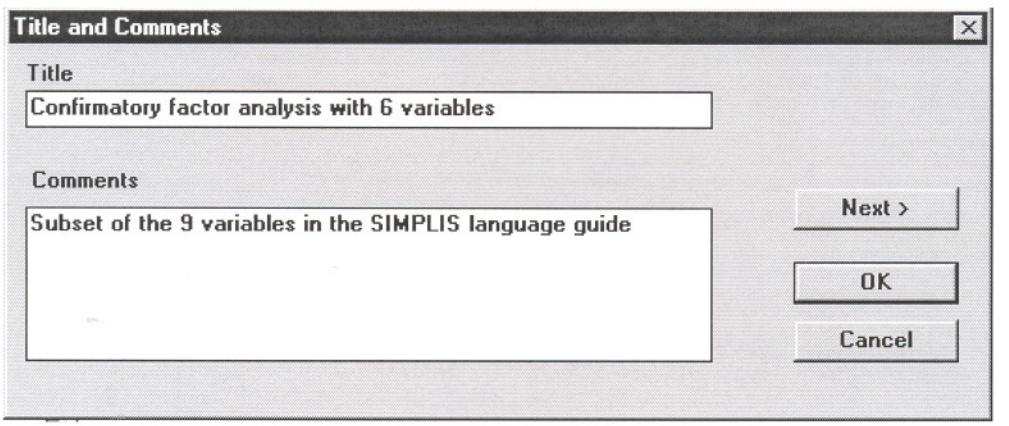
Before drawing the path diagram, select ***Toolbars*** from the ***View*** menu and ensure that the items shown below are selected. These are: ***Toolbar, Status Bar, Typebar, Variables, Drawing Bar***. Optionally, also check the ***Grid Lines*** option.



Select the ***Title and Comments*** option from the ***Setup*** menu to obtain the ***Title and Comments*** dialog box.

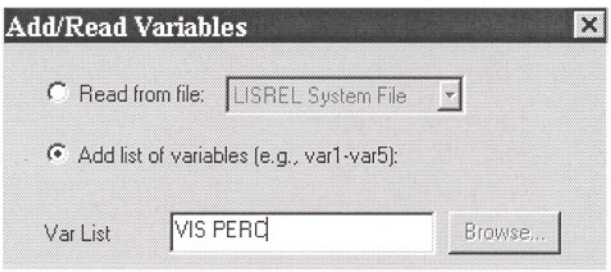


The first item on the ***Title and Comments*** dialog box is the ***Title*** for the particular analysis. Provision is also made for any additional ***Comments*** that the user may wish to enter. After typing in the title and (optionally) the comments, click on ***Next*** to go to the ***Group Names*** dialog box.

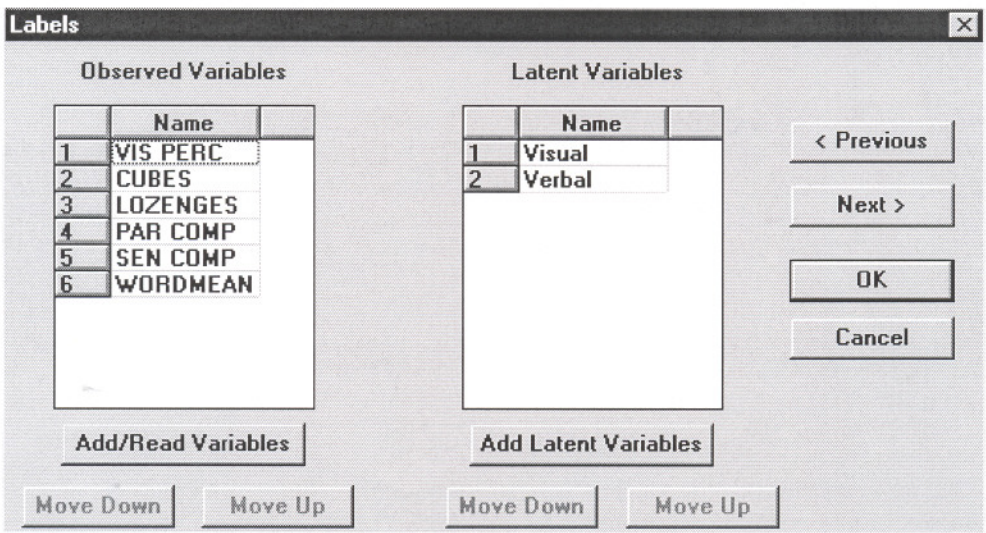


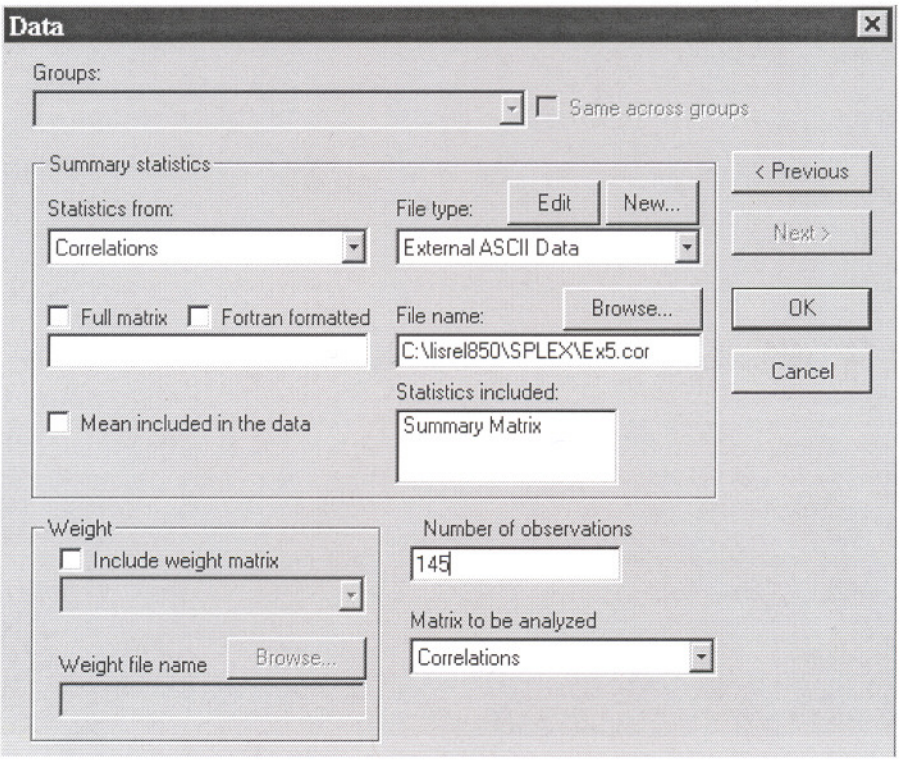
Since the present example is based on the analysis of one correlation matrix, nothing is entered in the space allowed for ***Group Labels*** and ***Next*** is clicked to go to the ***Labels*** dialog box. The default number of variables shown on the ***Labels*** dialog box is 2, these being *VAR 1* and *VAR 2*.

Since we have six observed variables, the ***Add/Read Variables*** option is selected. On the ***Add/Read Variables*** dialog box (of which the top half is shown below), check the ***Add list of variables*** radio button. Enter the labels *VIS PERC*, *CUBES*, …, *WORDMEAN* one by one in the ***Var List*** field. Note that a label name, which may include blanks, may not exceed 8 characters.



Since there are 2 latent variables, *Visual* and *Verbal*, the procedure outlined above for the observed variables is repeated by selecting ***Add List*** on the ***Latent Variables*** portion of the ***Labels*** dialog box. Add *var1-var2* and click ***OK***. Assign labels to these latent variables by clicking on the number of each variable. Finally, click ***Next*** to go to the ***Data*** dialog box.





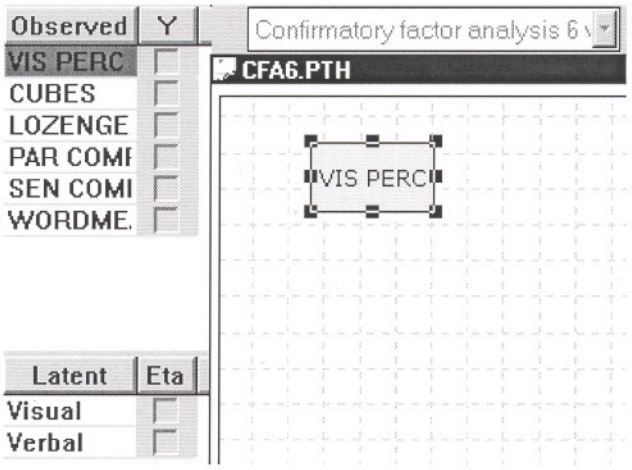
Select ***Correlations*** from the ***Statistics from*:** drop-down list box and also ***Correlations*** from the ***Matrix to be analyzed*** drop-down list box. In the ***Number of Observations*** string field type `145`. For ***File type***, select ***External ASCII Data*** and use the ***Browse*** button to locate **exs.cor** in the **splex** folder. Click ***OK*** when done.

4.3.2 Drawing the Path Diagram

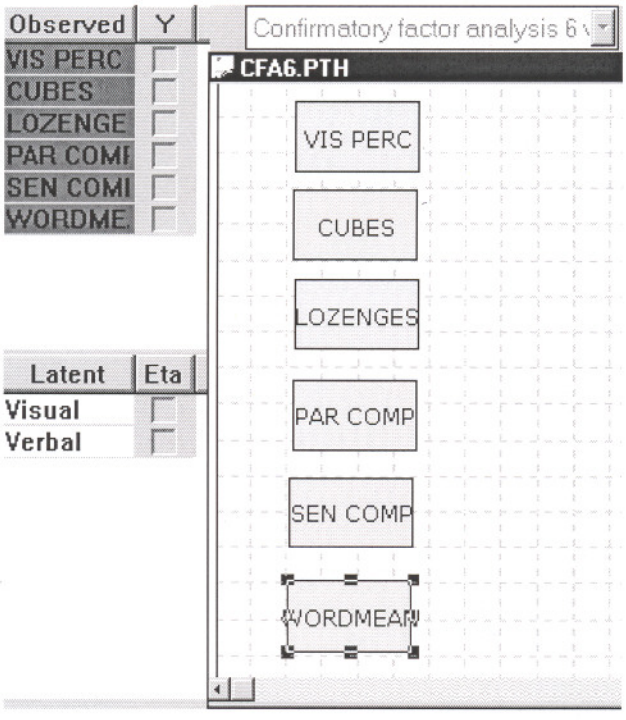
We now proceed with the actual drawing of the path diagram. Start by clicking on the *VIS PERC* label under the ***Observed*** variables portion of the ***Labels*** window. Hold the mouse button down and "drag" the label to the draw area indicated by the grid lines. A rectangular-shaped object will appear on this part of the screen when the mouse button is released as shown below. Note also that

- The observed variables are assumed to be *X* (or independent) variables unless appropriate squares under the ***Y***-column are clicked.

- The latent variables are assumed to be *KSI* (or independent) variables unless appropriate squares under the ***Eta***-column are clicked.



Repeat the same procedure for each of the remaining 5 variables by clicking on a label (left mouse button) and dragging the object to the draw area on the screen. The result of these operations should look similar to the image given below:

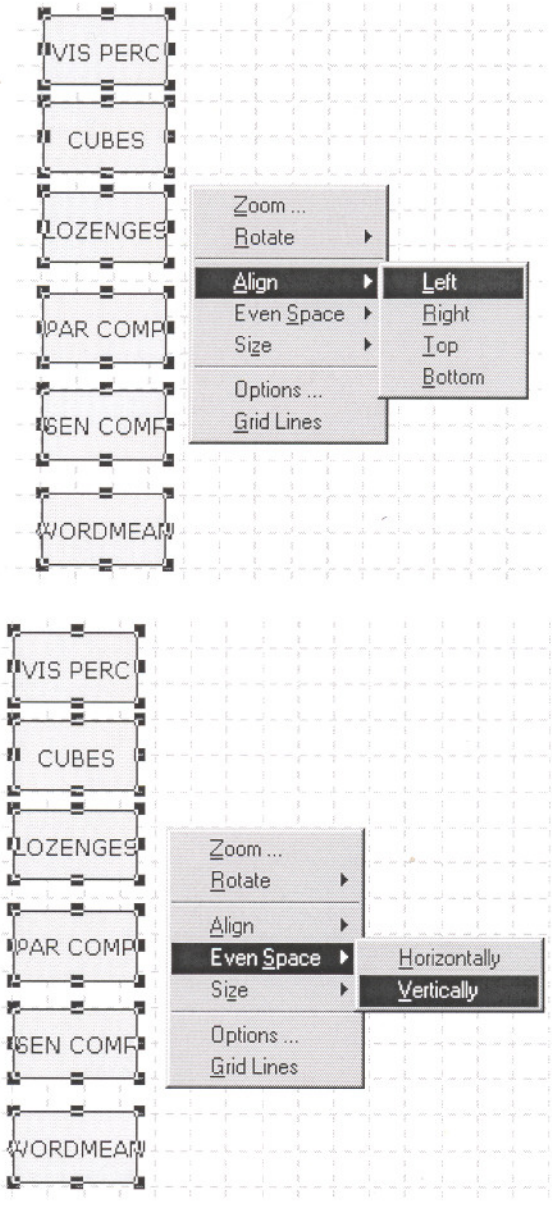


The rectangles representing the six observed variables can be properly aligned by going through the following steps:

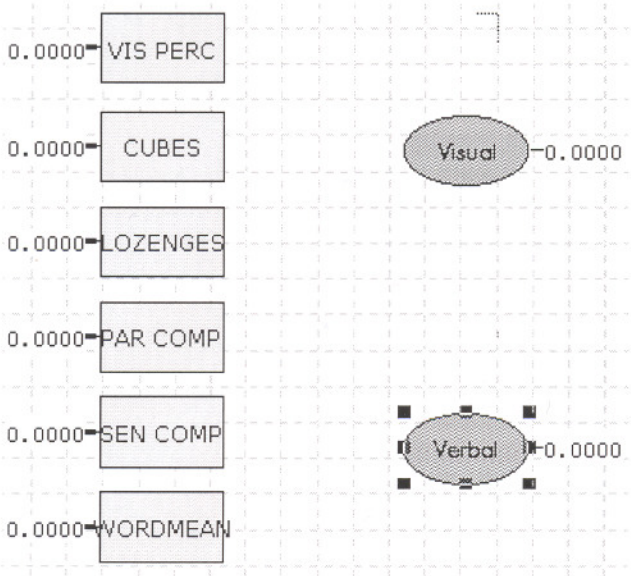
- Choose ***Select all*** from the ***Edit*** menu, or draw a rectangle with the mouse pointer around all the objects to be included.

- Move the mouse pointer to the vicinity of the selected objects and click the right mouse button. The menu shown below will appear on the draw part of the screen.
- Select the ***Align>Left*** option. Once this is done, select the ***Even Space>Vertically*** option. One can, alternatively, use the ***Align*** option on the ***Image*** menu to achieve this.

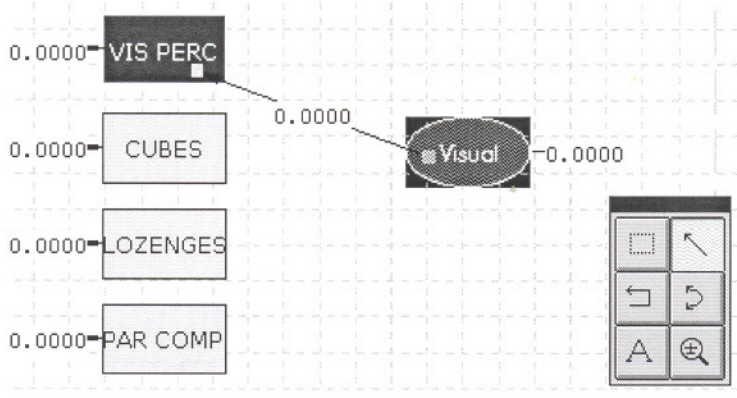
Note that the alignment of objects is not really necessary. Once syntax is built from the path diagram and the program is run, a properly aligned path diagram is displayed.



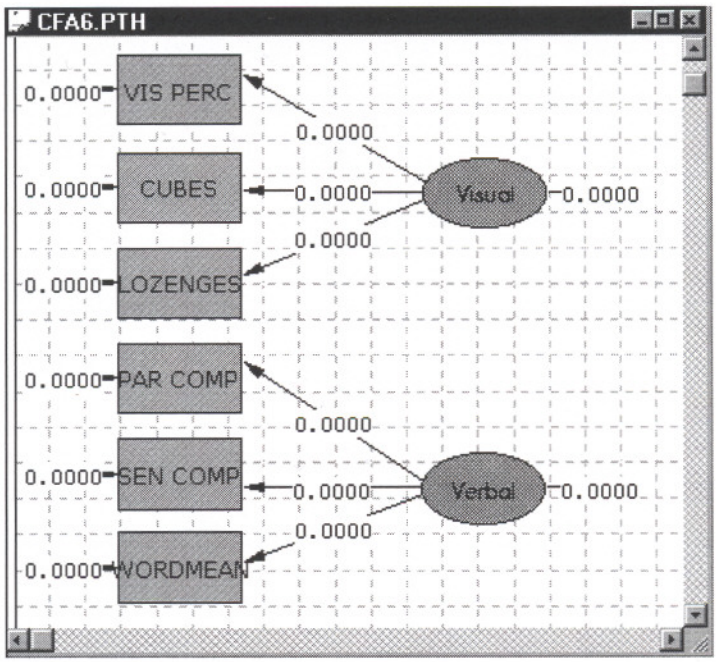
The rectangular objects will now be aligned and one can proceed by dragging the latent variables, *Visual* and *Verbal* to the path diagram window. Note that *latent* variables are represented by elliptically shaped objects.



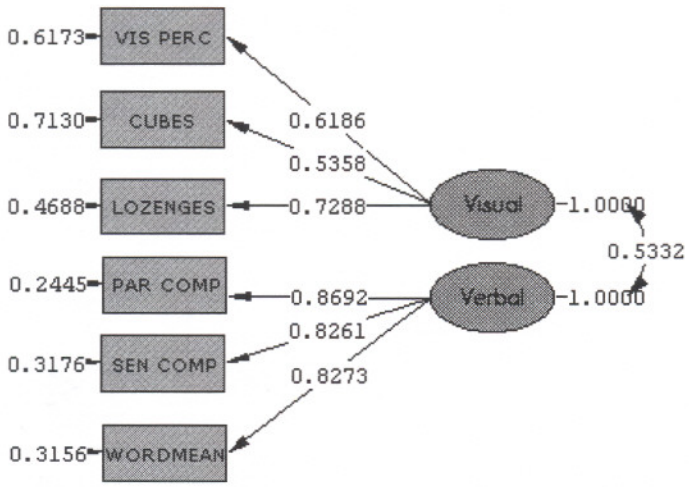
Finally, arrows can be drawn pointing from the latent variables to the observed variables. To accomplish this, click on the single-headed arrow of the ***Draw*** toolbar (seen on the right of the picture given below) and move the mouse pointer to within one of the elliptically shaped objects. With the left mouse button held down, drag the arrow to within a rectangular-shaped object. When the colors of both objects change (see diagram below) release the mouse button. Note that the ***Draw*** menu on the main menu bar can also be used when drawing path diagrams. Related draw tool options are contained in this menu.



Proceed in a similar fashion to graphically display the relationships between the observed and latent variables as shown on the next image.



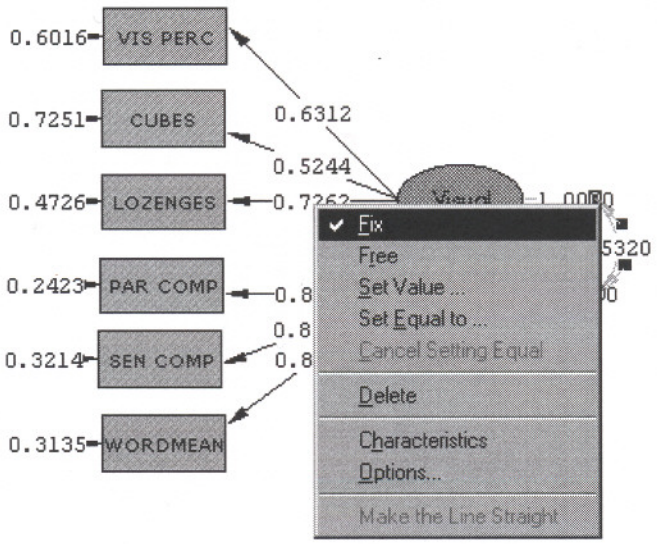
Select the ***Build SIMPLIS Syntax*** option from the ***Setup*** menu. SIMPLIS syntax (not shown below) will be built from the path diagram and is stored in a system file named **cfa6.spj**. Click the ***Run LISREL*** icon button to fit the CFA model to the data. Parameter estimates are shown on the path diagram given below.



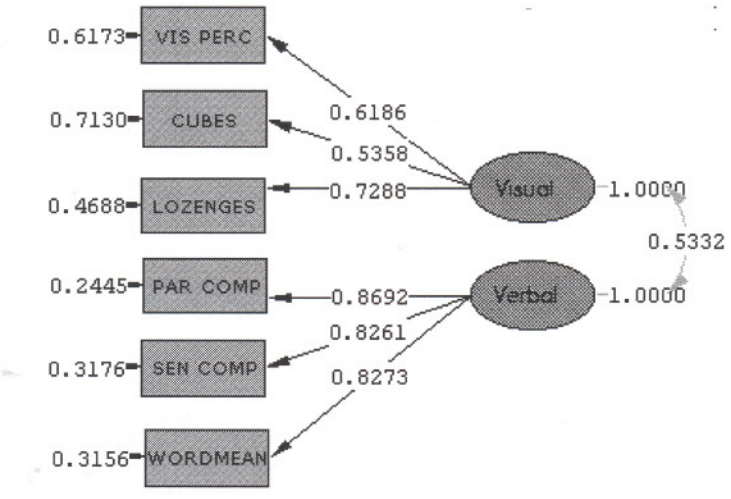

```
Chi-Square=4.37, df=8, P-value=0.82193, RMSEA=0.000
```

By altering the path diagram, model specifications may be changed. The covariance between *Visual* and *Verbal* may, for example, be fixed by clicking (right mouse button)

on the two-headed arrow representing this covariance. This will enable the pop-up menu shown below. Select the ***Fix*** option using the left mouse button.



Click the ***Run LISREL*** icon button to fit the revised CFA model to the data. The path diagram, χ^2-fit statistic and RMSEA are shown below.



Chi-Square=4.37, df=9, P-value=0.88514, RMSEA=0.000